The discovery of anesthesia occurred during a narrow time span in the mid-19th century, but there is no agreement about who deserves credit for this important American contribution to medicine. Based mostly on an examination of primary sources, we explore how formal and informal interactions between the principals affected their careers, lives, and attribution of credit for the discovery of anesthesia. There should be no controversy as to which individual deserves credit for the discovery of anesthesia if credit is ascribed for specific contributions. We suggest that credit for the discovery of anesthesia be divided among 4 individuals who played specific roles. Crawford W. Long first used ether as an anesthetic during surgery, Horace Wells introduced nitrous oxide for pain relief during dental surgery, and William T. G. Morton gave the first public demonstration of ether anesthesia and spread the word about its efficacy. Charles T. Jackson suggested the use of ether as an anesthetic agent to Morton. We also assert that had these individuals not known one another, the discovery of anesthesia would have proceeded in approximately the same timeframe, but Wells, Morton, and Jackson would have enjoyed more productive careers as well as longer, more peaceful lives.

**Keywords:** Discovery of anesthesia, Charles T. Jackson, Crawford W. Long, W. T. G. Morton, Horace Wells.
Horace Wells attended a demonstration in Hartford, Connecticut, on December 10, 1844, during which Gardner Quincy Colton (1814-1898) administered nitrous oxide to a volunteer, who injured himself while descending from the stage but did not experience pain under the influence of residual nitrous oxide. Colton was aware of the mind-altering effects of nitrous oxide and left medical school to make money as a traveling lecturer and demonstrator. The morning after the demonstration, Colton administered nitrous oxide, and fellow dentist John Riggs (1810-1885) painlessly extracted one of Wells’ teeth. However, history has denied Colton the honor of being the first individual to administer nitrous oxide for painless dental extraction, and Riggs for being the first individual to have conducted such a procedure. Wells administered nitrous oxide for pain relief during dental procedures both in Hartford and in Boston, Massachusetts. He conducted a partially successful demonstration of nitrous oxide analgesia at Massachusetts General Hospital (MGH) in Boston in early 1845, but the attempt was dismissed by the audience as humbug because the obtunded subject cried out when the tooth was extracted. The subject later denied remembering any pain, but Wells did not further examine this aspect. His career took a downward spiral that ended in his suicide 4 years later, as explained later, in the “Aftermath” section. Wells is recognized by dentists and the City of Hartford, Connecticut, as the discoverer of anesthesia, and his statue in the city’s Bushnell Park celebrates his important role.

William Thomas Green Morton received dental training at the newly established Baltimore (Maryland) College of Dental Surgery and in 1842 formed a brief partnership with Horace Wells, starting a dental practice in Boston. Morton was present during Wells’ nitrous oxide demonstration at MGH but was acutely aware that he would need to do something different to administer anesthesia for a surgical procedure. Morton had successfully rendered birds, fish, and his pet dog unconscious; he was on the lookout for a human volunteer when Ebenezer (“Eben”) Hopkins Frost appeared on his doorstep on the evening of September 30, 1846, seeking relief for severe toothache. Morton administered ether to Frost during a painless dental extraction. Thereafter, he administered ether to other patients and convinced surgical staff at MGH to allow him to demonstrate the efficacy of ether as an anesthetic.

Surgeon John Collins Warren, MGH founder and chief of surgery, would be expected to be skeptical about this proposal. However, Warren was equally aware of the great benefits that would accrue to surgical patients worldwide if Morton were able to relieve pain during the operation. Permission was granted, and history was made on October 16, 1846, when Morton succeeded in the first public demonstration of ether anesthesia, in which Warren removed a mass from the neck of Edward Gilbert Abbott (1825-1855). Warren admitted that they had witnessed a major breakthrough, certainly not humbug. The 7-minute operation required about 7 weeks’ in-hospital recuperation, likely because of wound sepsis. Sterile technique was unknown at this time, and antibiotics would not be discovered for another century.

Charles Thomas Jackson had been consulted by Wells and Morton when they developed an implantable dental device. Morton stayed in touch with Jackson, who later suggested that ether might be a more potent and effective anesthetic than nitrous oxide. Jackson played no other role than offering this suggestion, and it was Morton who developed ether’s subsequent use. Jackson was unaware of the public demonstration, claiming credit in hindsight, especially when economic rewards could be reaped from the discovery. Jackson had visited Long in Georgia and discussed the use of ether anesthesia, but this occurred in 1854, several years into the controversy.

Interactions Among the Antagonists
Morton first met Wells when the latter visited his father at the Morton household in Charlton, Massachusetts. Later, Morton became an apprentice to Wells, learning dentistry from him and finally becoming a business partner for a brief period. Morton was aware of the analgesic effects of nitrous oxide, and as mentioned earlier, he was present during Wells’ partially successful demonstration of nitrous oxide analgesia at MGH in early 1845. In fact, Morton helped Wells secure permission to demonstrate the anesthetic properties of nitrous oxide to John Collins Warren and his senior medical students at Harvard Medical School. However, like the demonstration at MGH, the event was only partially successful, since the patient cried out in pain during the dental extraction. The onlookers dismissed the episode as a farce, and as Wells left the room, the spectators laughed and hissed at his apparent failure. As Morton later recalled, “the meeting broke up and we were looked upon as
having made ourselves very ridiculous."21 Determined never to find himself in such an embarrassing situation again, he left no stone unturned as he prepared himself for the fateful hour on October 16, 1846.16

There is evidence to suggest that Morton and Wells may have traveled to Georgia to observe ether administration by Long.23,26 If this is true, the concept of using ether as an anesthetic may have occurred to Morton even without Jackson’s suggestion. Another obvious question arises: Why did Wells not use ether? The answer may lie with Wells’ own satisfactory dental extraction under the influence of nitrous oxide, and the success he achieved when he used it on his own patients. The patient’s unsatisfactory response in Boston may have been due to inhalation of a dilute mixture of nitrous oxide, a delay between administration and extraction, premature discontinuation of nitrous oxide, or suboptimal anesthetization in an unfamiliar setting.

Morton listed himself as a pupil of Jackson in March 1844 before formally enrolling in Harvard Medical School—at that time called Massachusetts Medical College—as a student in November 1844.27 Jackson had graduated from the same medical school but had abandoned clinical practice in favor of chemistry and geology. Jackson had experimented with inhalation of ether vapor to relieve discomfort associated with inhalation of noxious fumes such as chlorine that he encountered working in his chemistry laboratory. However, Morton was also aware of these effects, having experimented on animals and himself. In late September 1846, Morton approached Jackson for a rubber bag, claiming that he wished to administer atmospheric air to a woman who otherwise refused to have a tooth extracted.2 The purpose of this visit and borrowing the rubber bag remains unclear. Morton may have merely wished reassurance that ether was the right agent to use on humans. In any case, he obtained the equipment from Jackson and used ether successfully in late September 1846 and on October 16, 1846. Although the identity of the individual who coined the term Ether Day is not known, the discovery of ether is celebrated on October 16 each year at MGH.

Aftermath

In mid-19th-century America neither the dental nor the medical profession was held in high esteem, primarily because there were few barriers to entry for anyone who desired practicing these occupations. The curriculum at medical schools was ill defined, and not much time or money was required to complete medical studies.28 Despite this, between 1790 and 1849 only 20% to 35% of practicing physicians in the New England states had graduated from a medical school.29 The situation with dentists was no better. Even discerning consumers had difficulty identifying an uneducated quack practicing dentistry. In the early 1800s diploma mills offered degrees in dentistry for fees ranging from $5 to $20. Economic difficulties in the 1830s drove many unemployed mechanics to take up dentistry, with a doubling in the number of dentists by 1836.30

Morton did not disclose the identity of the anesthetic agent used on October 16, 1846, merely calling it Letheon after the mythical river Lethe, which erases memory. Anticipating rival claims by Jackson, Morton and Jackson jointly filed a patent application for the use of ether as an anesthetic in 1846.14 The aim was to get a certain amount of money for each use of ether. Moreover, Morton had plans for establishing a nationwide network of salesmen who could distribute an ether vaporizer designed by him. The medical community expressed displeasure at the commercialization of this great medical advance, and after a few days MGH refused to allow Morton to administer anesthesia unless he divulged the identity of the agent. Wells and Long became aware of Morton’s plans and of the dispute that arose between Morton and Jackson as their partnership soured.

Each of these 4 remarkable men had his supporters, and the lobbying and acrimony associated with their claims for the discovery of anesthesia made it impossible for any authority to clearly indicate which individual most deserved the credit.1,14,20,21,31 The US government had decided to award $100,000 for the discovery of anesthesia; however, the funds were never dispersed because of an inability to determine which individual deserved to win.

Wells’ personal life took a tragic turn after he returned from a prolonged trip seeking support in France. He began to abuse ether and chloroform and was arrested in New York City for splashing acid on some women. While imprisoned, he convinced prison officials to allow him to briefly visit his office to collect important belongings. He surreptitiously picked up a small bottle of chloroform and a razor. He was found dead in a bathtub with a chloroform-soaked handkerchief near his face and a laceration of his femoral artery.32,33

Jackson and Morton battled over the government award and credit for the discovery of anesthesia for decades, making their case to Congress and the courts, but to no avail. The nation’s attention was focused on the Civil War in the 1860s, and there was little interest in or patience for this duel. After the war, the Atlantic Monthly magazine published an article suggesting that Jackson deserved credit for the discovery of anesthesia. Morton wrote to the editor several times, but not receiving a reply, he decided to pursue the matter in person.34 It was a very hot summer in New York, and Morton grew ill while he waited for an audience with the publisher. Later, traveling through Central Park in a horse carriage, he became agitated and delirious while suffering heatstroke and jumped into a pond. Although details of his clinical condition are not available, he was taken urgently to St Luke’s Hospital, where he died on July 15, 1868.35
Years later, while Jackson was visiting Mount Auburn Cemetery in Cambridge, Massachusetts, someone mentioned that the grave of the discoverer of anesthesia (W.T.G. Morton) was located in this cemetery. Jackson flew into a rage when he heard this and subsequently suffered a long-term neuropsychiatric disability. After a few months at home, his family admitted him to the McLean Institute of the Insane in Massachusetts, where he died several years later on August 28, 1880.\(^{33,35}\) Jackson's clinical diagnosis and institutionalization are poorly documented, but there is evidence that he was offered room and board at McLean for services rendered to MGH, and not because of any mental impairment. Jackson sought credit as the discoverer of anesthesia, stating that he had suggested the use of ether to Morton. He claimed to have conceived the idea and that Morton had merely acted as a technician. Jackson also claimed to have invented telegraphy by instructing Samuel Morse (1791-1872) on how to conduct his work.\(^{36}\)

The only claimant to remain relatively unaffected by the battle and acrimony that accompanied the claim of discovering anesthesia was the person who deserved it the most – Crawford Williamson Long. It has been said, “long did Long have to wait for recognition.” He continued medical practice in rural Georgia and died a natural death on June 16, 1878, many years after everyone else seemed to have forgotten about their disputes.\(^{5}\)

**Were the Interactions Among the Principals Helpful or a Hindrance?**

The events we describe have already occurred and their veracity confirmed. The following counterfactual narrative examines how the story might have unfolded had these individuals not known one another. Such examinations have also been applied by military historians seeking to imagine how the outcome of a battle might have been different if certain variables were altered. The nature of our inquiry makes it speculative, and no new facts are brought forward. We explore the interactions in the order in which they occurred and suggest how history might have been rewritten.

In writing about her father, Frances Long Taylor implied that Morton and Wells visited Long and observed his use of ether during surgery.\(^{6,26}\) Although names are not clearly stated, we find it difficult to believe that this visit occurred. Wells and Morton were extremely keen on decreasing pain during dental procedures, not only to reduce suffering, but equally important, to encourage patients to consent to dental procedures. Had they observed the successful use of ether during surgery at the hands of Long, they would undoubtedly have explored this option in their practice. Since the latter did not occur, we suggest that Morton and Wells did not visit Long in Jefferson, Georgia.

It has been suggested that Wells paid a professional visit to Morton's home in Charlton, Massachusetts, to call on James Morton (W. T. G. Morton's father), although the date is not known.\(^{23,24}\) Morton received formal training in dentistry at the Baltimore College of Dental Surgery, after which he established a practice in Farmington, Connecticut, approximately 12.8 km (8 mi) from Hartford. Morton was likely influenced by Wells' advertisements and obtained informal training from Wells for a fee. In 1843, they formed a business partnership, with Morton being responsible for work in Boston; however, the partnership was dissolved after only 3 weeks.\(^{10,14,23,29}\) There is no evidence that Morton was present at Gardner Quincy Colton's demonstration of nitrous oxide, a most fateful event attended by Wells, his wife, and fellow dentist John Riggs. However, Morton was present during Wells' partially successful demonstration of nitrous oxide at Harvard Medical School. He concluded that nitrous oxide was not sufficiently reliable and experimented with ether. Although he was confident about ether's ability to render an individual unconscious, he did seek reassurance and obtain equipment from Jackson. We do not know whether Wells would have decided to demonstrate his discovery in Boston if he had not made the acquaintance of Morton. If not, he might have continued using nitrous oxide for dental procedures and been recognized as the discoverer of its anesthetic properties. Sooner or later, surgical procedures would have been attempted under nitrous oxide, and its lack of potency revealed. Moreover, if Morton had not become familiar with the analgesic effects of nitrous oxide through his relationship with Wells, it is unlikely that he would have stumbled upon the anesthetic properties of ether until Long or some other individual had publicly announced or reported on it. Thus, Morton's relationship with Wells allowed him to learn about the capability of nitrous oxide to dull pain, but the partial failure of Wells' demonstration in Boston also taught Morton that nitrous oxide lacked potency. His drive and inquisitiveness led him to seek out a more potent agent. “Ether frolics” were common, and Morton experimented with the drug until he was convinced of its efficacy. We believe Morton would have proceeded with a clinical trial of ether on Eben Frost on September 30, 1846, even without advice from Jackson. Moreover, this success would compel him to proceed with the fateful public demonstration on October 16, 1846.

We believe that the pain-relieving properties of nitrous oxide and ether would eventually have been discovered without the principals being acquainted with one another. Wells' contribution as the discoverer of the analgesic effects of nitrous oxide would remain unchanged, since this occurred without any input from Morton. It is difficult to speculate what role Morton might have played in the discovery of anesthesia had he not sought instruction from and partnership with Wells. Jackson, too,
would have no role to play in the discovery of anesthesia had Morton not learned of the possibility of painless dentistry under Wells. It is therefore possible that a single individual would receive credit for the discovery of the pain-relieving properties of both nitrous oxide and ether. In that event, there would have been no 2-decade long dispute following the introduction of anesthesia in 1846.

Wells’ fateful association with Morton might have led him to the Boston demonstration. Had that not occurred, Wells might have had a long and distinguished career in Hartford, Connecticut. Although speculating on possible alterations in Morton’s subsequent life is conjecture, it could conceivably have been better than the bitter 20-year fight for recognition that he endured. He died having suffered great personal and financial difficulties, without getting the recognition he so coveted. Jackson may have continued his long and successful career as a geologist without being encumbered by the temptation of seeking fame and fortune through the discovery of anesthesia. He would likely have had a more natural death had he not gone into a fit of agitation upon hearing the mention that the discoverer of anesthesia was Morton. Among the protagonists, Long’s career and life would likely have been least affected by the minimal contact he had with Wells and Morton.

Conclusion
Modern readers find it inconceivable that a dispute for such a major medical discovery could persist for so long without resolution. History reminds us that there is a very good reason why combatants persist with prolonged conflict: they are convinced that they are right. Patent laws were in place, as was the judicial system, but these individuals sought recognition from their peers, physicians, medical organizations, and research academies both within and outside the United States. They also lobbied directly and indirectly to members of Congress.

We propose a simple solution to end this persistent controversy. Each of these individuals played an important role in the discovery of anesthesia, and therefore each ought to get some credit. The individual deserving most credit is Crawford Williamson Long for being the first to administer ether for pain relief during a surgical procedure. He cited various reasons for the 7-year delay in publishing his findings in a medical journal. Moreover, his practice was confined to a rural community in Georgia. These 2 factors ensured that information about the anesthetic property of ether would not receive widespread recognition and also prevented him from receiving due credit. Horace Wells deserves credit for introducing nitrous oxide as an anesthetic, especially for short dental procedures. Charles Thomas Jackson ought to get little credit, or perhaps just an honorable mention, for suggesting to Morton that he should use ether to achieve anesthesia, and also for instructing him on its use. However, it is likely that Morton already knew about the anesthetic properties of ether and had only come to Jackson to borrow equipment. William Thomas Green Morton was the last one to make any contribution, but he deserves credit for the widespread publicity the discovery received, not only as a result of his successful public demonstration but also from his commercial pursuits and battle for recognition.

We suggest that the discovery of anesthesia would have occurred in approximately the same timeframe had these individuals not known one another. However, it would have been less tragic for the principals. Their careers and lives would almost certainly have been longer and less acrimonious.

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